Demand Estimation Sub Committee

3.1 Ad Hoc Workplan Update
Day of the Week Review
6 Mar 2024

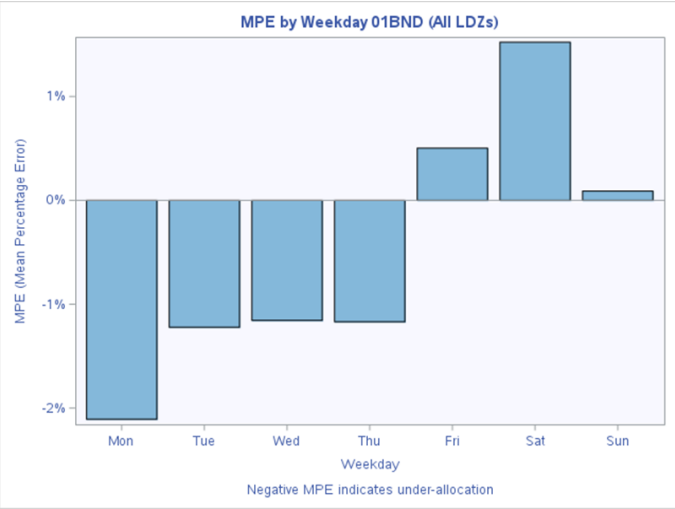
Contents

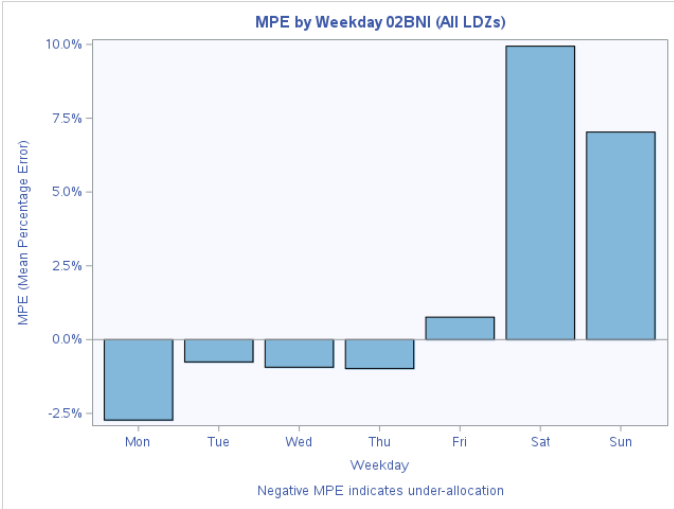
Day of the Week Review

OVERVIEW

Background

- Historically, non-holiday Mondays to Thursdays have been used as the core base for modelling purposes
- This works on the basis that, on each of the core days, consumers exhibit similar behaviour patterns
- In the 2021/22 Algorithm Performance Review, Mondays were found to be showing different residuals to those of Tuesday to Thursday for some EUCs (examples below)





Objectives

- The primary objective is to determine if the current grouping of Monday to Thursday non-holidays for baseline modelling purposes is still appropriate

- An additional objective is to review the different weekend rules for domestic and non-domestic EUCs

Approach

- The algorithm performance process was used to see where the day of week consumption patterns no longer conform to the current modelling rules/assumptions
- **Baseline Days (Monday to Thursday)** - the residuals by day of week for the latest 3 Gas Years' Algorithm Performance reviews, were investigated to identify any trends in the demand patterns
  - These are Gas Years 2019-20, 2021-22 and 2022-23 for all EUCs except 01BND, however 2019-20 has also been included for 01BND
  - Gas Year 2020-21 Algorithm Performance was for 01BND only due to the impact of Covid-19 on the other EUCs
- **Weekend Rules** – 3 different options (based on the current rules) were modelled and compared with the Algorithm Performance results for the live rules
  - This information was then be used to devise new rules for testing
  - The test rules were used to 'remodel' previous years, and then the revised output tested to see if the algorithm performance and UIG improved

Tests

- For this Analysis, the different models have been compared using a comparison of Residuals
  - The residual is the difference between the Forecast Volume and the Actual Volume
  - The smaller the residual, the closer Forecast Volume is to the Actual Volume

- To allow year-on-year comparison the residual has been converted to a Mean Percentage Error (MPE)

- Any rule changes would need to improve the Algorithm Performance (R^2) and UIG over the period being tested in order to be adopted

- As changing the ‘Monday to Thursday non-holiday rule’ would require development, improvements would need to be significant, and trends would need to be consistent over multiple years and for the majority of EUCs

Day of Week Review

ANALYSIS – BASELINE DAYS

Analysis – Baseline Days

- It is a key principle in DESC's Modelling Approach document, that Monday to Thursday, non-holidays, are grouped together to create the baseline demand model
  - The same approach is used to optimise the CWV (Composite Weather Variable)

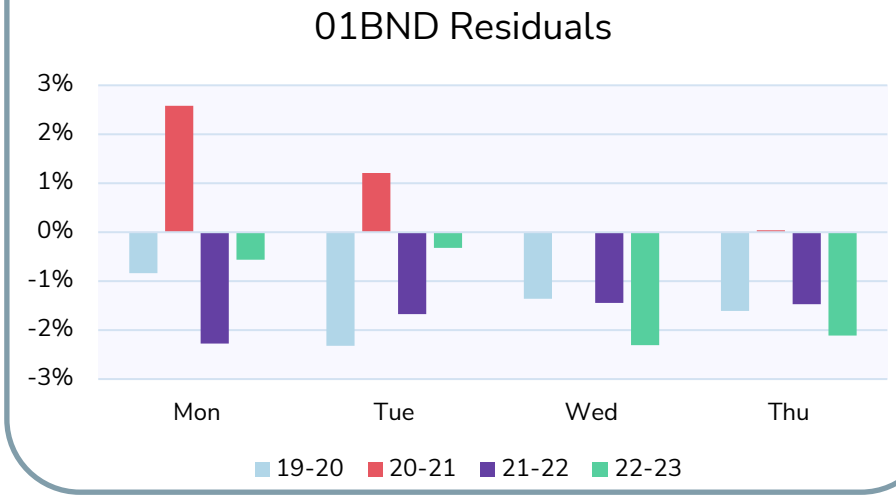
- For more information on the modelling principles and methodology see the NDM Algorithms Booklet, Section 3 - Gas Demand EUC Modelling Structure here

- Note: the most recent versions of the day of the week residuals for Gas Year 2022/23 are available in the Strand 3 NDM Algorithm Accompanying Document

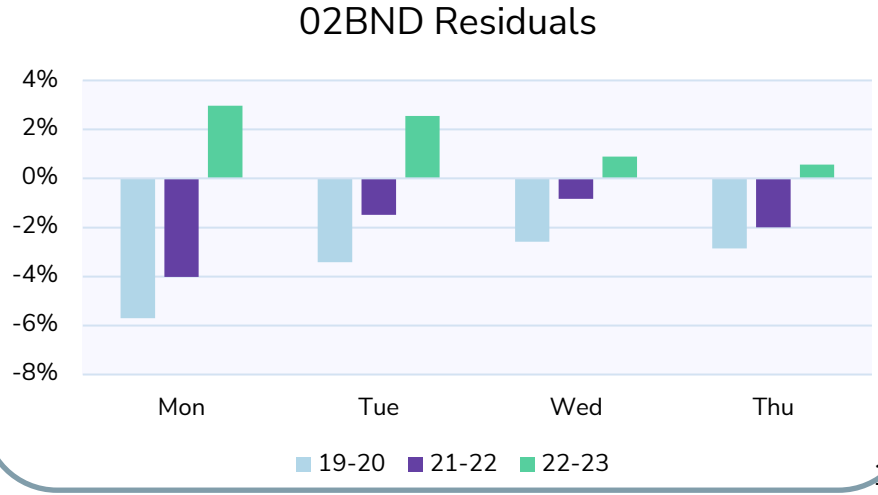
Analysis – Baseline Days - Domestic

- The Monday to Thursday residual error percentages (MPEs - Mean Percentage Errors) are shown for Domestic EUCs 01BND and 02BND below

There is no consistent evidence of Monday residuals being different than the other core day. All 4 years show a range of results for all core days.



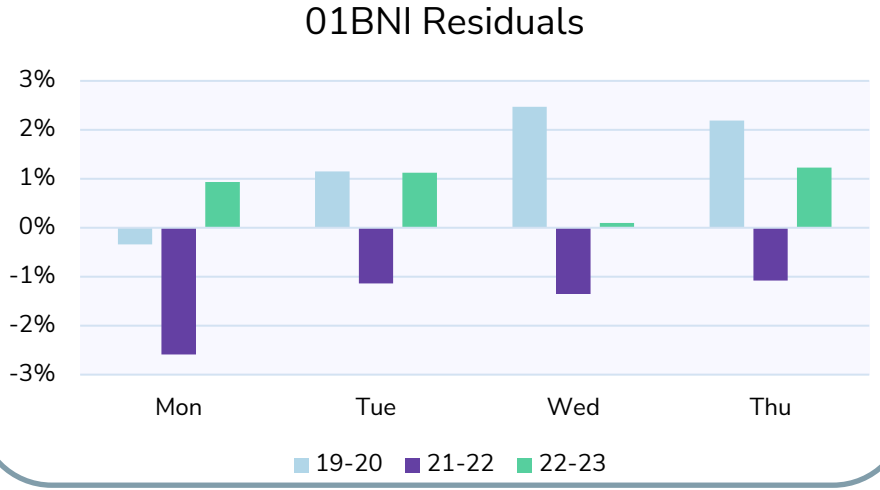
Monday has the largest residual for all three Gas Years. However, all days show different variances and there is no consistent variance between any one day and the average.



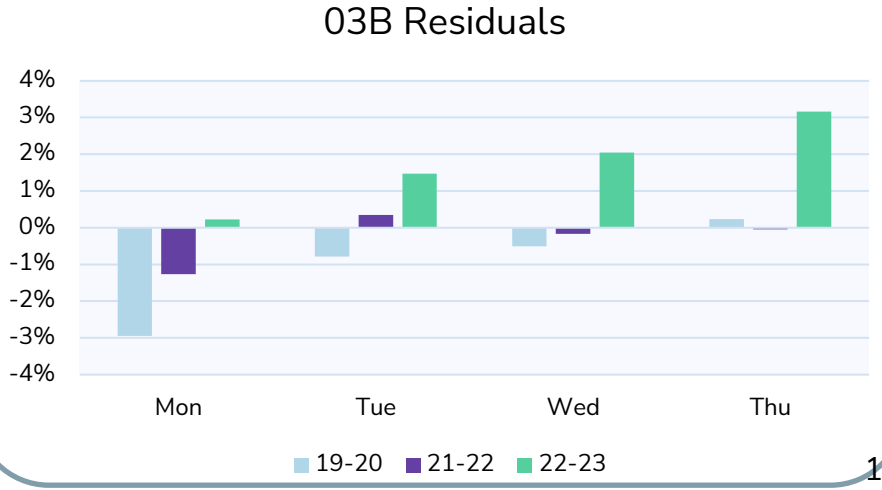
Analysis – Baseline Days – Small I&C

- The Monday to Thursday residual error percentages (MPEs - Mean Percentage Errors) are shown for Small I&C EUCs 01BNI and 03B below

Monday shows a different level residual to the other weekdays for 19-20 and 21-22. For 22-23 Monday is in line with other core days



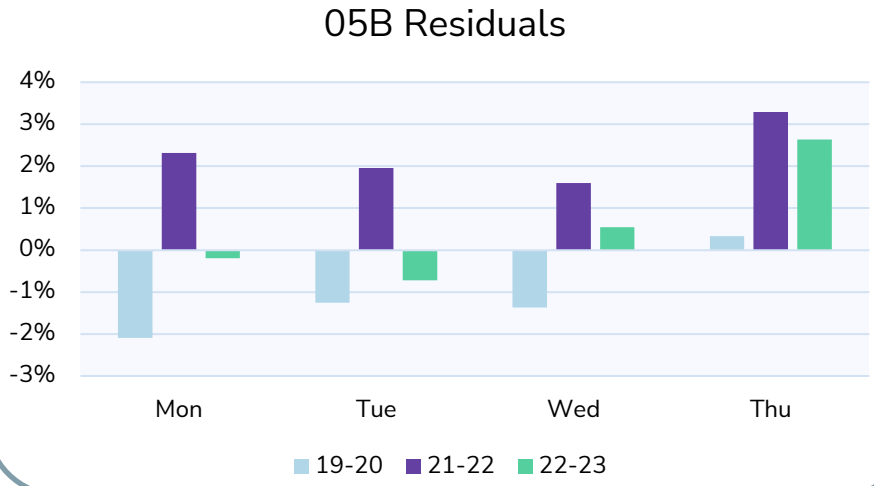
The variances suggest a trend of reduced consumption over the week with increasing residuals. All days show different residuals, and there is no consistency.



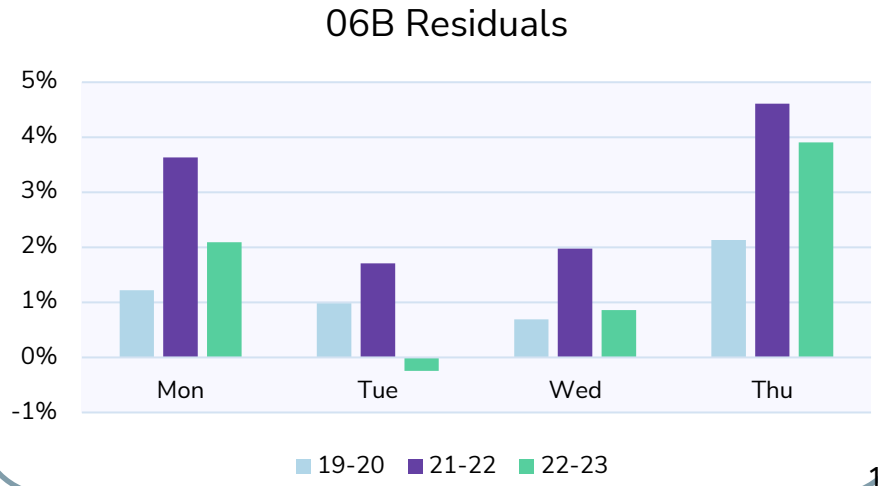
Analysis – Baseline Days – Large I&C

- The Monday to Thursday residual error percentages (MPEs - Mean Percentage Errors) are shown for Large I&C EUCs 05B and 06B below

Variances for 05B are quite varied; Thursday residuals are slightly higher for all years, however whilst this is the case for 05B, it is not seen in the other I&C EUC



Tuesday and Wednesday show lower residuals than Monday and Thursday. This is worth monitoring, but changing the core to only 2 days is unlikely to be feasible.



Baseline Days – All EUCs

- The table on the right shows the difference in average residual percentage for Mondays vs Tuesday to Thursday for each EUC

  e.g. for 01BND 2019-20

  the Average Residual for Monday is-0.84% and the average Residual for Tuesday to Thursday is -1.76%

  so the variance for Mondays is on average 0.9%

- Highlighted values show variances greater than 2%
- 01BPD and 07B show a consistent positive variance
- 02BNI, 03B and 04B show a consistent negative variance
- Whilst these are consistent in direction, they are not significant and vary for the same market sector codes

Monday Variance to Tuesday-Thursday			
	2019-20	2021-22	2022-23
01BND	0.9%	-0.7%	1.0%
01BNI	-2.3%	-1.4%	0.1%
01BPD	0.9%	0.6%	2.6%
02BND	-2.8%	-2.6%	1.6%
02BNI	-2.0%	-1.3%	-1.1%
03B	-2.6%	-1.3%	-2.0%
04B	-2.6%	-1.4%	-2.2%
05B	-1.3%	0.0%	-1.0%
06B	0.0%	0.9%	0.6%
07B	3.0%	2.8%	1.5%
08B	-0.7%	1.5%	-0.1%

- There is no consistent evidence of Monday residuals being different than the other core days

Conclusions – Baseline Days

- As with all recent analysis, external drivers, such as high energy prices, have clearly impacted consumer behaviour in terms of conservation (e.g. AQ levels). In addition, other recent analysis (e.g. Strand 3), has revealed some indicators of change in terms of consumption patterns, making the results of the analysis harder to interpret.

- The variance for Monday in EUC 01BND was only observed for one of the three years analysed (Gas Year 2021-22) and even then, was not particularly significant
  - this is therefore likely to be due to a short-term behavioural change and not a trend

- None of the EUCs showed a consistent variance to the other baseline days

- The current approach of grouping Monday to Thursday non holidays appears to still be the most accurate for modelling purposes

- Day of week modelling will continue to be monitored and reported on as part of the Algorithm Performance Review (Strand 3)

Day of Week Review

ANALYSIS – WEEKEND RULES

Weekend Rules - Background

- Weekend Days (Fridays, Saturdays and Sundays) are modelled individually, and separate from the Baseline days of Monday to Thursday

- When the smoothing process takes place, rules determine if the weekend effects, from the individually modelled years, are included in the calculation based on their statistical significance

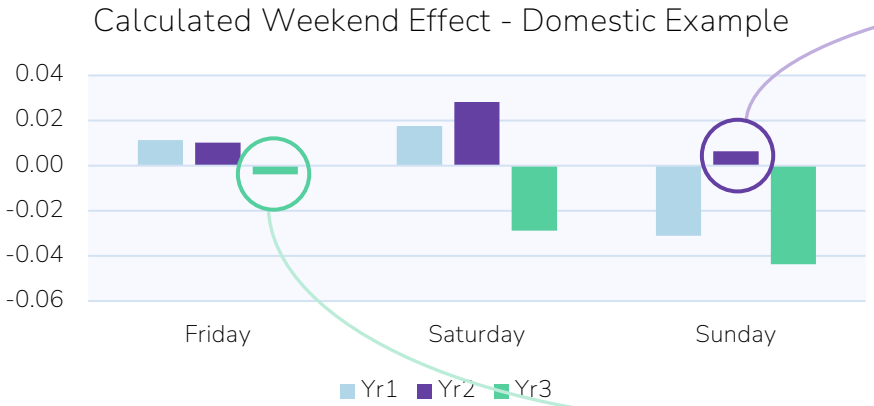
- The current rules differ for Domestic and I&C EUCs, and these are covered in more detail on the following slides, with the relevant wording from the Modelling Approach Document

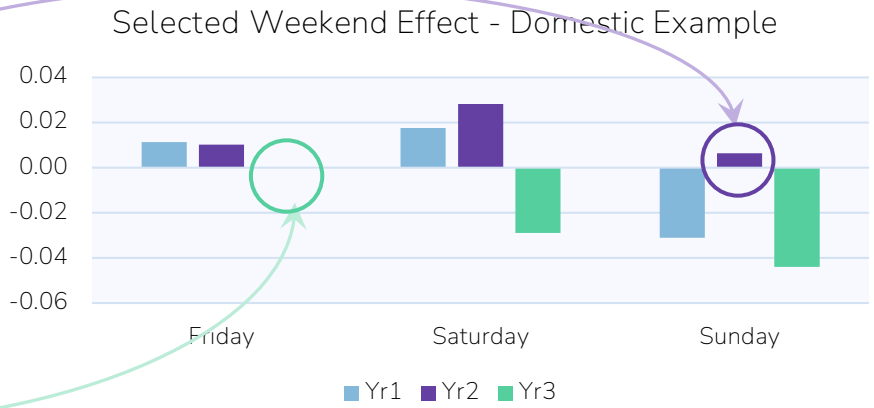
Weekend Rules – Domestic

- Weekend Rules - The following approach will be taken with respect to non-statistically significant (at the 95% confidence level*) weekend effects:
  - For those EUCs where the Gas Demand EUC Models is based on Domestic consumers (xx:Eyy01BND, xx:Eyy01BPD, xx:Eyy02BND and xx:Eyy02BPD) all positive non-significant weekend effects will be retained at their original value

*Note: non-statistically significant at 95% confidence level is +/- <2.5%

Non-significant **positives** are **retained**



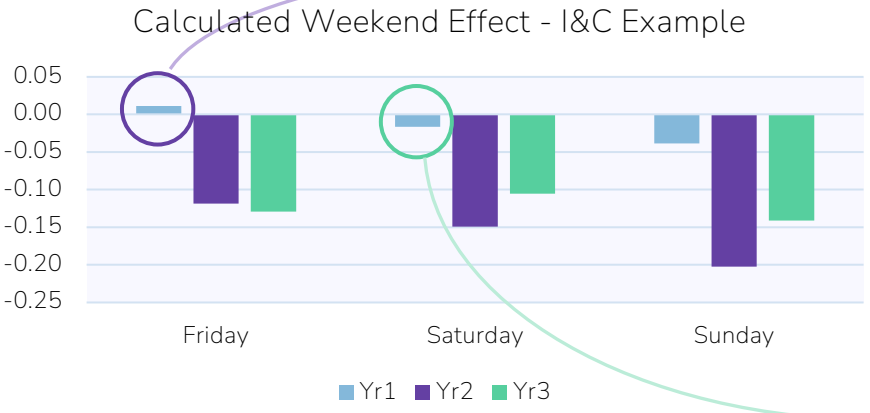


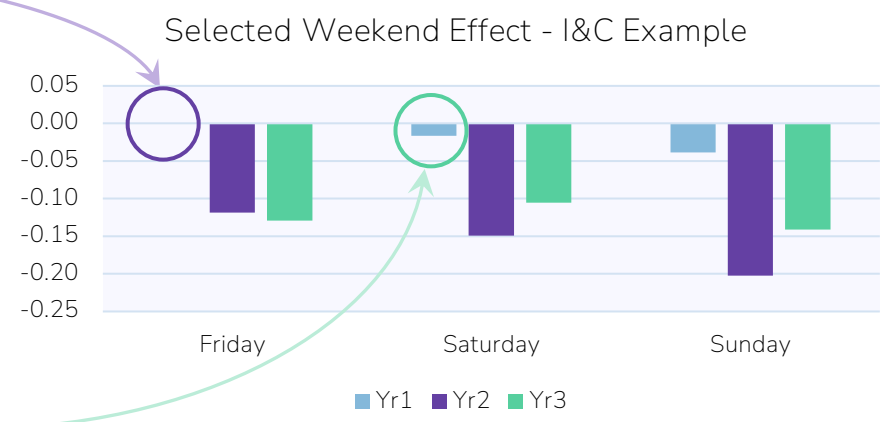
Non-significant **negatives** are **set to zero**

Weekend Rules – I&C

- Weekend Rules - The following approach will be taken with respect to non-statistically significant (at the 95% confidence level) weekend effects:
  - For all the remaining (i.e. non-Domestic) EUCs, all negative non-significant weekend effects will be retained at their original value

Non-significant **positives** are **set to zero**





Non-significant **negatives** are **retained**

Weekend Rules - Approach

- To test if the rules are producing the most accurate models, 3 alternatives were modelled
  1. The rules were switched, with domestic using the I&C rule, and I&C using the Domestic rule
  2. The Statistical Significance requirement was removed, and all effects were passed through to smoothing
  3. The Statistical Significance requirement was applied in all cases and only the statistically significant results were passed through to smoothing

- As any changes to Weekend rules have an impact on the other weekdays, the full year MAPE (Mean Absolute Percentage Error) and MPE (Mean Percentage Error) has been compared

- Day of Week MPEs have also been compared, to see the impact of the rules on the weekdays and individual weekend days

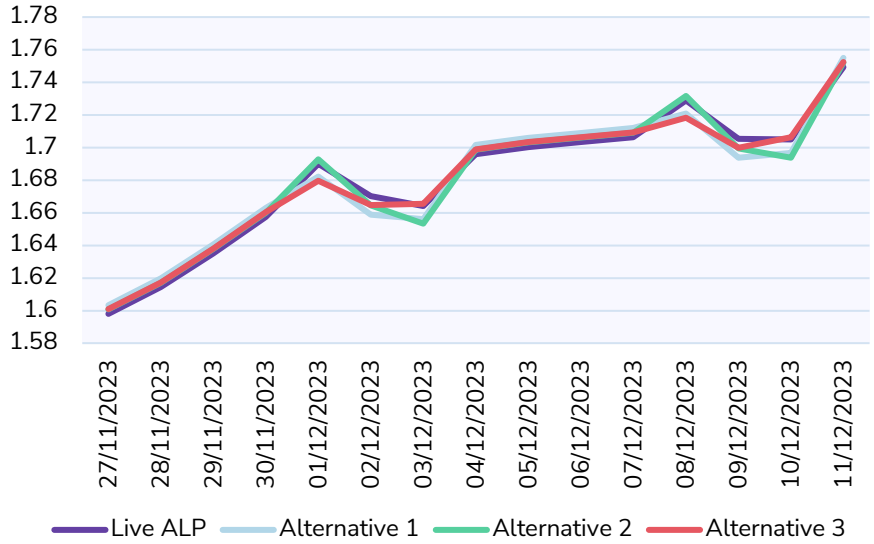
Weekend Rules – Initial Findings

- There was very little difference in the results for all EUCs
- The Domestic EUCs modelled produced a slightly different set of results in the majority of cases
  - Domestic EUCs tend to have smaller weekend effects, so they are more often classed as statistically insignificant
- For 50 of the 130 I&C EUCs modelled, all results were identical
  - For the remaining 80 models, alternative 2 produced the same results as the live model, and alternative 1 produced the same results as alternative 3
  - This means all non-significant effects were negative

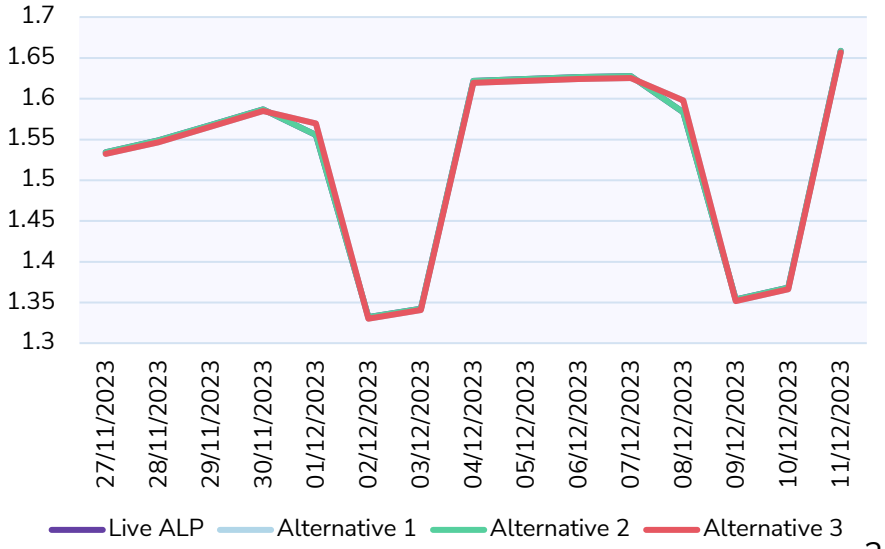
Weekend Rules – Example ALPs

- The charts below show a 2-week snapshot for a Domestic EUC and an I&C EUC with the current rules and the alternative rules
- As covered on the previous slide, there are only 2 unique ALPs for the I&C example

EM 01BND



SE 03B



Weekend Rules – MAPE Results

- The table below shows the **overall*** Mean Absolute Percentage Error (MAPE) for the live models and the 3 alternatives

EUC	Live Model	Alternative 1	Alternative 2	Alternative 3
01BND	7.52%	7.50%	7.51%	7.51%
01BNI	11.22%	11.24%	11.22%	11.24%
01BPD	8.83%	8.87%	8.86%	8.87%
02BND	10.62%	10.64%	10.63%	10.62%
02BNI	6.92%	6.93%	6.92%	6.93%
03B	7.14%	7.14%	7.14%	7.14%
04B	6.59%	6.59%	6.59%	6.59%
05B	8.71%	8.71%	8.71%	8.71%
06B	9.50%	9.50%	9.50%	9.50%
07B	17.83%	17.83%	17.83%	17.83%
08B	20.16%	20.16%	20.16%	20.16%

There is little difference in the values

- Alternative 1 produced marginally better results for 01BND (statistically insignificant at 0.02% better than live), however the other Domestic EUCs were better with the current rules
- There was very little difference in the I&C results and no alternative produced better results than the existing rules

***overall** MAPE is for all days for the full Gas Year of 2022-23

Weekend Rules – MPE Results

- The table below shows the **overall*** Mean Percentage Error (MPE) for the live models and the 3 alternatives

EUC	Live Model	Alternative 1	Alternative 2	Alternative 3
01BND	-0.42%	-0.42%	-0.42%	-0.42%
01BNI	0.09%	0.09%	0.09%	0.09%
01BPD	0.00%	0.01%	0.01%	0.01%
02BND	1.01%	1.01%	1.01%	1.01%
02BNI	0.81%	0.81%	0.81%	0.81%
03B	1.08%	1.08%	1.08%	1.08%
04B	1.34%	1.34%	1.34%	1.34%
05B	1.99%	1.99%	1.99%	1.99%
06B	2.86%	2.86%	2.86%	2.86%
07B	3.61%	3.61%	3.61%	3.61%
08B	3.58%	3.58%	3.58%	3.58%
Overall	2.29%	2.29%	2.29%	2.29%

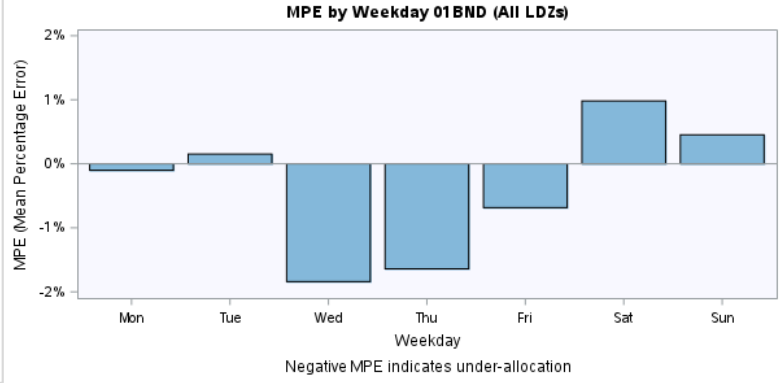
- There is negligible difference in the values, and only one EUC shows any difference at 2 decimal places (01BPD)
- The following slides show a day of week breakdown for 01BND and 02BNI

***overall** MPE is for all days for the full Gas Year of 2022-23

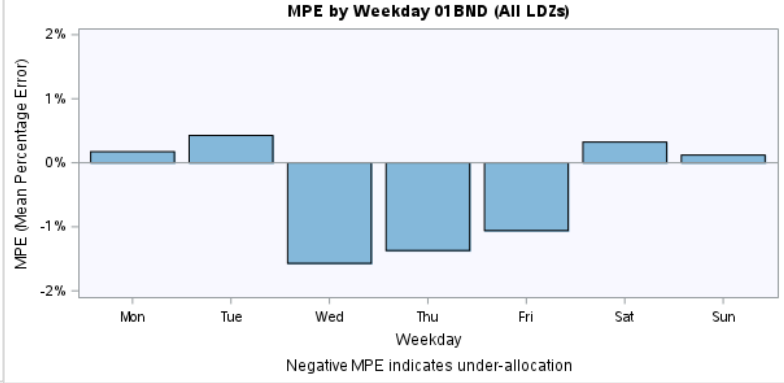
Weekend Rules – 01BND Results

- Whilst Saturday MPEs are better for Alternatives 1 and 3, Friday MPEs have deteriorated
- As ALPs must average 1 for each day in the Gas Year, changes to the weekend also impact weekdays

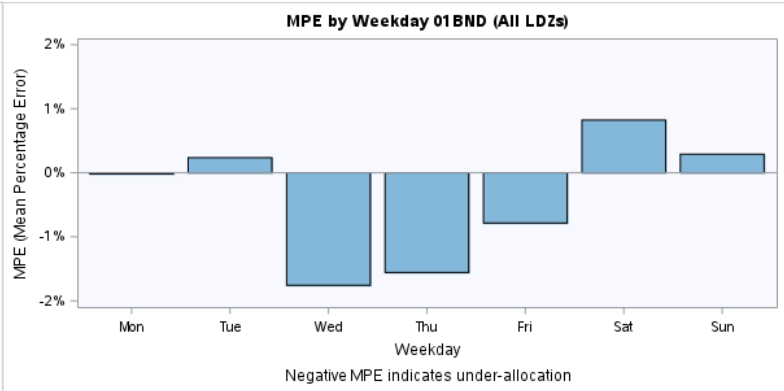
Live



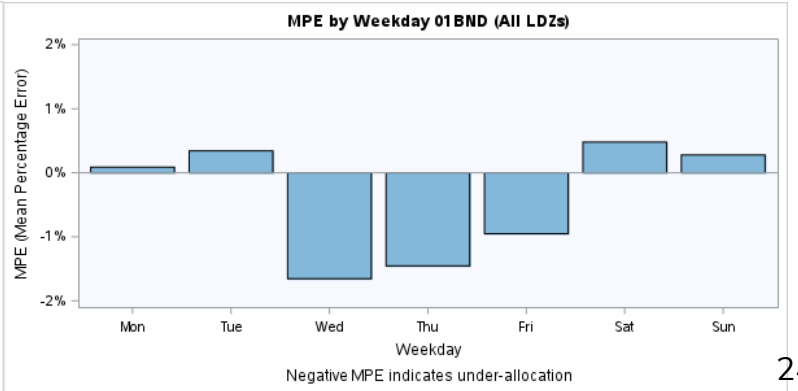
Alternative 1



Alternative 2



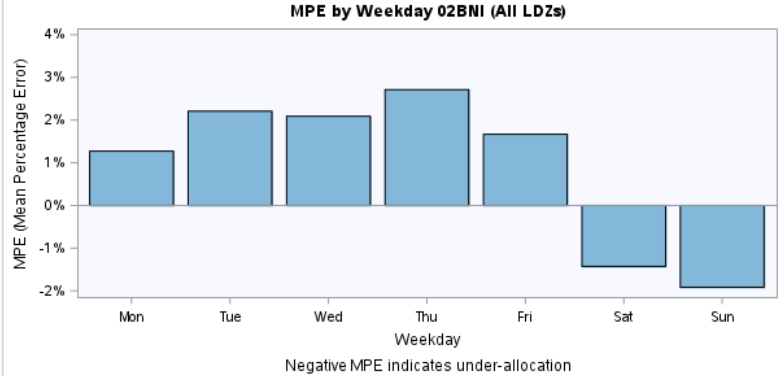
Alternative 3



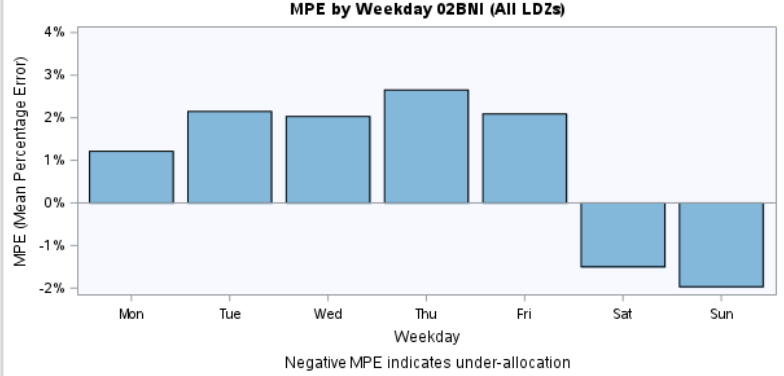
Weekend Rules – 02BNI Results

- The alternative rules had very little effect on the I&C EUCs and there is a negligible difference in the results by day of week

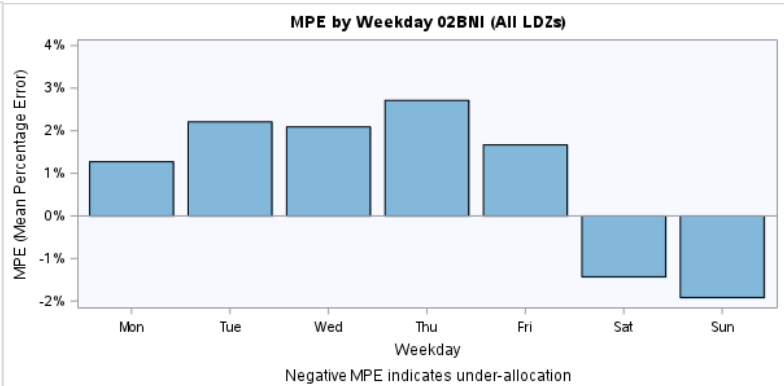
Live



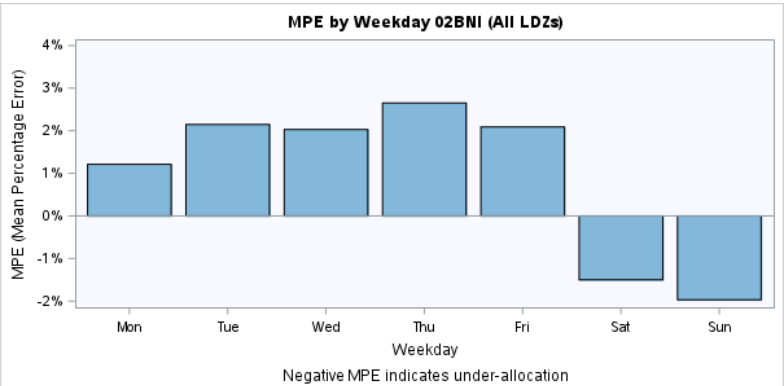
Alternative 1



Alternative 2



Alternative 3



Conclusions

- No changes are proposed for the Monday to Thursday Baseline days, the current grouping is the most appropriate given the results presented
  - As previously mentioned, improvements would need to be significant and reveal a consistent year-on-year trend to warrant a change, given the scale of work required
- No changes are proposed to the weekend rules
  - None of the alternatives produced any results better than the live rules
- Day of Week modelling results will continue to be reported as part of the Algorithm Performance Review and any unusual results can be investigated as part of a future Ad Hoc Workplan
- The Monday to Thursday non holiday demand relationship will be further tested during this year's CWV formula optimisation